JAXA Programs in Terrestrial Water Cycle Observations

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Japan Aerospace Exploration Agency

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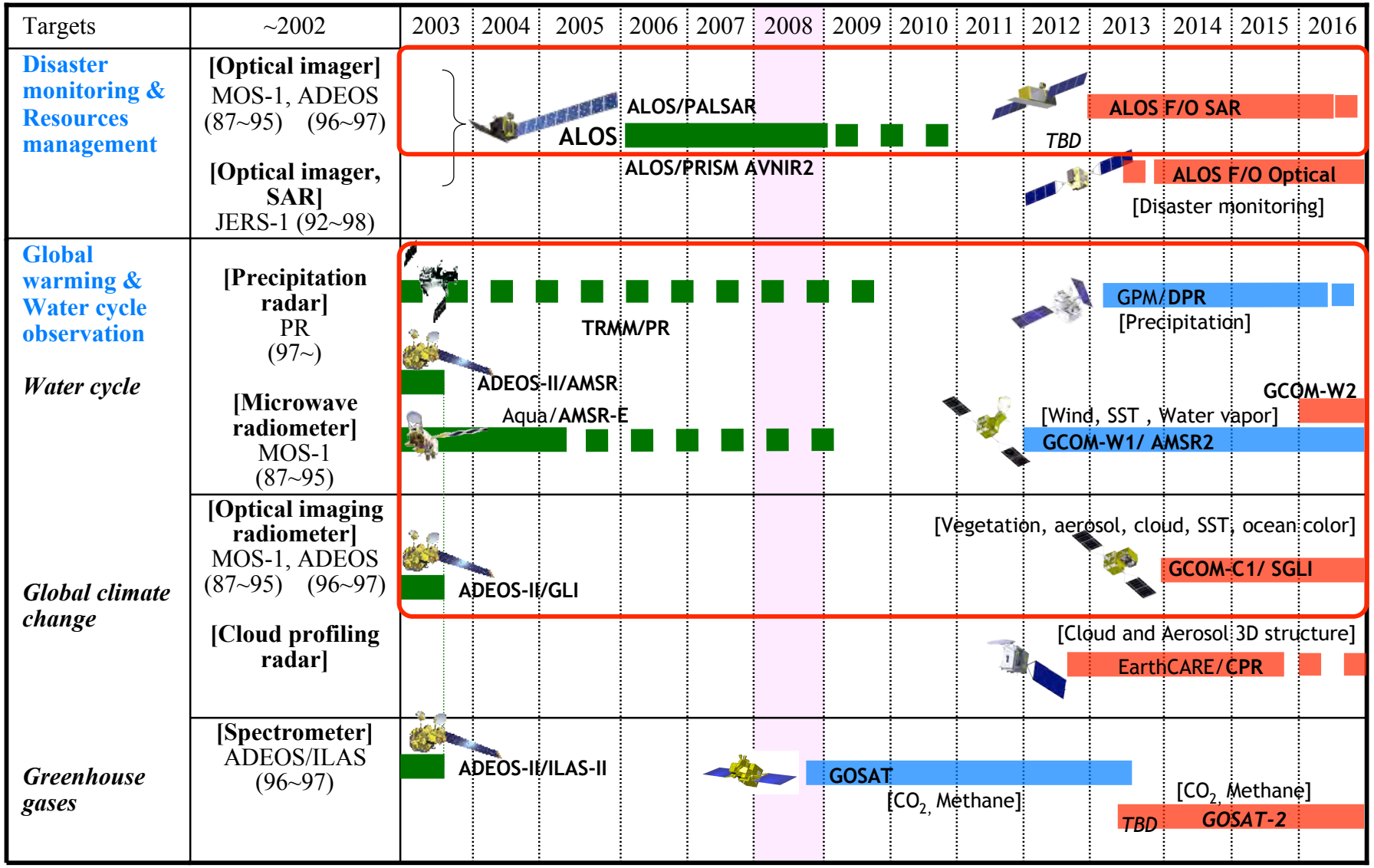
JAXA Earth observation satellites



Aqua/AMSR-E

- **Mission status**
  - Continuous observation over 6-years after the launch on May 4, 2002 onboard NASA's EOS Aqua satellite.
  - Stable brightness temperature records, except the loss of 89GHz-A data from November 2004.
  - Operation of the Aqua satellite will be maintained at least until 2011, according to NASA senior review.
- **Instrument characteristics**
  - Multi-frequency microwave radiometer with dual polarization capability (developed by JAXA).
  - High-spatial resolution compared to existing instruments by large size antenna.
  - C-band (6.9GHz) channels for estimating SST and soil moisture.
  - Afternoon (1:30 pm) equatorial crossing time that is currently unique for microwave radiometers.

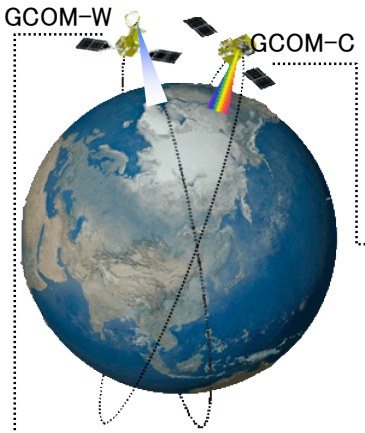
Pre-launch AMSR-E in Tsukuba Space Center

Global Change Observation Mission

Main responsibility of JAXA

Cooperation with the climate model research institutions

Satellite observation



Frequent and long-term (>10yer) global observation system required for earth environment change monitoring and prediction

GCOM observation

Radiation budget
- Surface forcing
- Snow ice
- Cloud aerosol
- Temperature

Carbon cycle
- Land cover
- Primary production
- Coastal environment

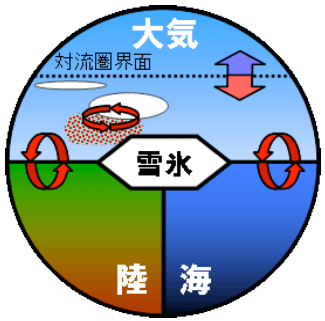
Water cycle
- Water vapor, cloud, precipitation
- Soil moisture
- Sea ice, snow
- SST, wind

Input

Comparison

Model prediction

Climate system model



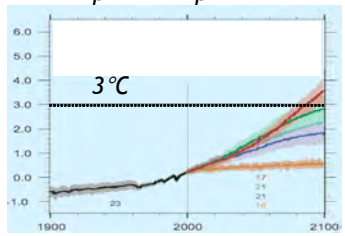
- Improvement of parameterization about radiation budget and carbon cycle, etc. in climate prediction model.
- Verification and improvement of prediction of the earth environment change including the water cycle by comparison with the satellite observation.

Improve accuracy

Prediction results

- Surface temperature
- Sea level
- Snow and sea ice area
- Environmental change
- Rain distribution
- Extreme weather frequency
- Land cover

Air temperature prediction



Data application

Knowledge

Scenario

Operational use

Data distribution to the operational organization which performs fishery information service, sea route information, weather forecast management, etc.

monitoring and understanding of the earth environment change

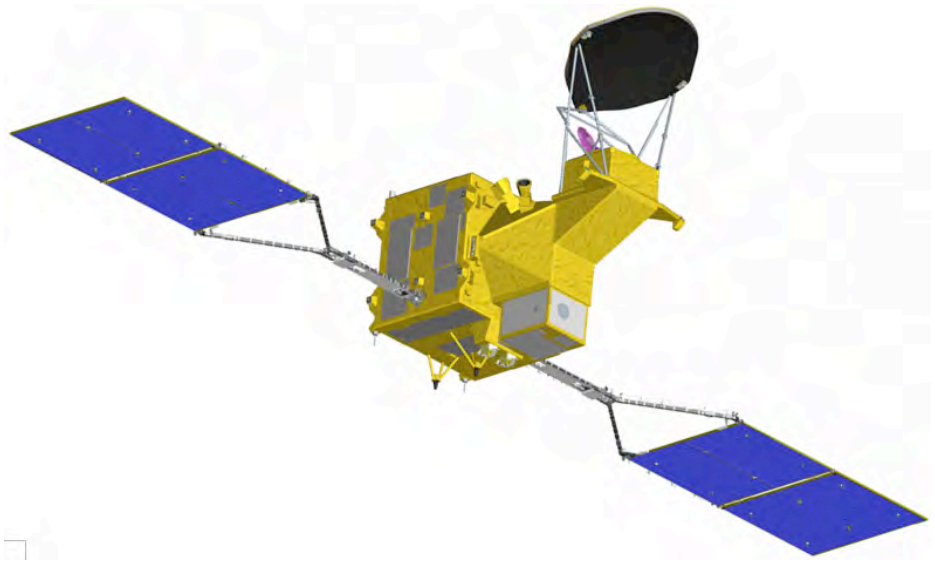
Continuous monitoring of the earth environment change and improvement of the mechanism understanding

Policy design

improvement of prediction accuracy of the environmental change (degree, area and impact), and contribution to the design of policy for taking measures against adaptation.

GCOM 1st generation

GCOM-W1 (Water)

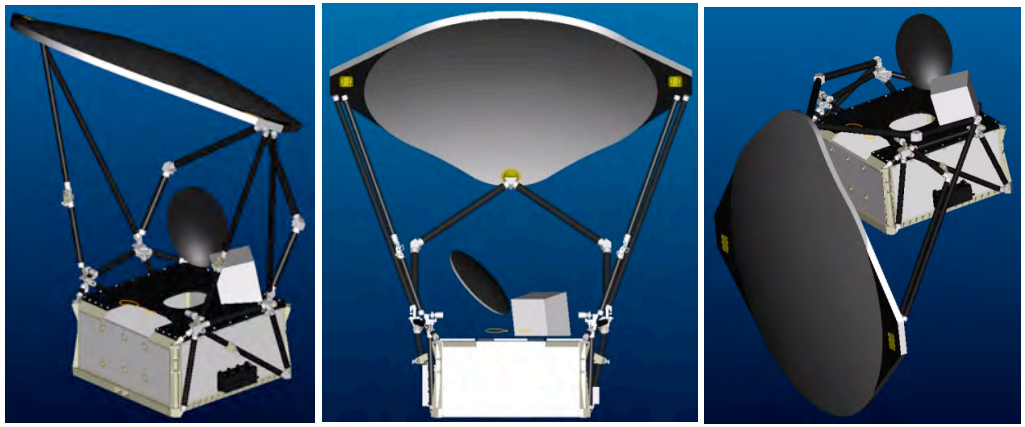


GCOM-C1 (Climate)

Instrument	**Advanced Microwave Scanning Radiometer-2**
Orbit	Sun Synchronous orbit Altitude : 700km, Inclination: 98.2 deg.
Size	5.1m (X) * 17.6m (Y) * 5.0m (Z) (on-orbit)
Mass	1940kg
Power	4050W @ EOL
Launch	JFY2011
Design Life	5-years
Status	Phase-C

Instrument	**Second-generation Global Imager**
Orbit	Sun Synchronous orbit Altitude : 798km, Inclination: 98.6 deg.
Size	4.6m (X) * 16.3m (Y) * 2.8m (Z)
Mass	1950kg
Power	4250W @ EOL
Launch	JFY2013 (TBD)
Design Life	5-years
Status	Phase-B

AMSR2 Instrument



Deployed　　Stowed

- Deployable main reflector system with 2.0m diameter.
- Frequency channel set is identical to that of AMSR-E except 7.3GHz channel for RFI mitigation.
- Two-point external calibration with the improved HTS (hot-load).
- Deep-space maneuver will be considered to check the consistency between main reflector and CSM.

GCOM-W1/AMSR2 characteristics	
Orbit	Sun Synchronous with 699.6km altitude (over the equator)
Launch	JFY2011
Design-Life	5-years
Local time	13:30 LTAN
Swath width	1450km
Antenna	2.0m offset parabola
Incidence angle	Nominal 55 degree

AMSR2 Channel Set				
Center Freq. [GHz]	Band width [MHz]	Polarization	Beam width [deg] (Ground res. [km])	Sampling interval [km]
6.925/ 7.3	350	V and H	1.8 (35 x 62)	10
10.65	100		1.2 (24 x 42)	
18.7	200		0.65 (14 x 22)	
23.8	400		0.75 (15 x 26)	
36.5	1000		0.35 (7 x 12)	
89.0	3000		0.15 (3 x 5)	5

Tropical Rainfall Measuring Mission

- Major characteristics
  - Focused on rainfall observation. First instantaneous rainfall observation by three different sensors (PR, TMI, VIRS). PR, active sensor, can observe three-dimensional structure of rainfall.
  - Targeting tropical and subtropical region, and chose non-sun-synchronous orbit (inc. angle 35 degree) to observe diurnal variation.
- Major achievement in Japan
  - Demonstration of high quality and high reliability of a satellite onboard precipitation radar
  - Improvement of MWR precipitation retrieval by PR 3D observation
  - Pioneering precipitation system climatology by PR observation
  - Operational use in NWP etc.
  - New products including all-weather SST, global soil moisture

US-Japan joint mission

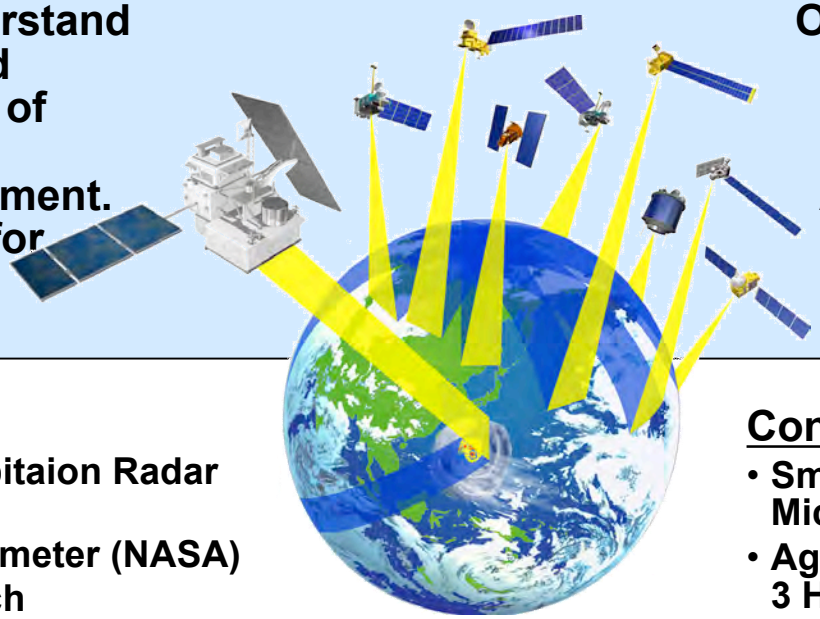
Japan: PR, launch

US: satellite, TMI, VIRS, CERES, LIS, operation

Launch	28 Nov. 1997 (JST)
Altitude	About 350km (since 2001, boosted to 402km to extend mission operation)
Inc. angle	About 35 degree, non-sun-synchronous orbit
Design life	3-year and 2month (still operating)
Instruments	Precipitation Radar (PR) TRMM Microwave Imager (TMI) Visible Infrared Scanner (VIRS) Lightning Imaging Sensor (LIS) CERES (not in operation)

Global Precipitation Measrement

OBJECTIVE: Understand the Horizontal and Vertical Structure of Rainfall and Its Microphysical Element. Provide Training for Constellation Radiometers.



OBJECTIVE: Provide Enough Sampling to Reduce Uncertainty in Short-term Rainfall Accumulations. Extend Scientific and Societal Applications.

Core Satellite

- Dual-frequency Precipitaion Radar (JAXA and NICT)
- Multi-frequency Radiometer (NASA)
- July 2013, H2-A Launch
- TRMM-like Spacecraft
- Non-Sun Synchronous Orbit
- ~65° Inclination
- ~407 km Altitude
- ~5 km Horizontal Resolution
- 250 m / 500m Vertical Resolution

Constellation Satellites

- Small Satellites with Microwave Radiometers
- Aggregate Revisit Time, 3 Hour goal
- Sun-Synchronous Polar Orbits
- 500~900 km Altitude

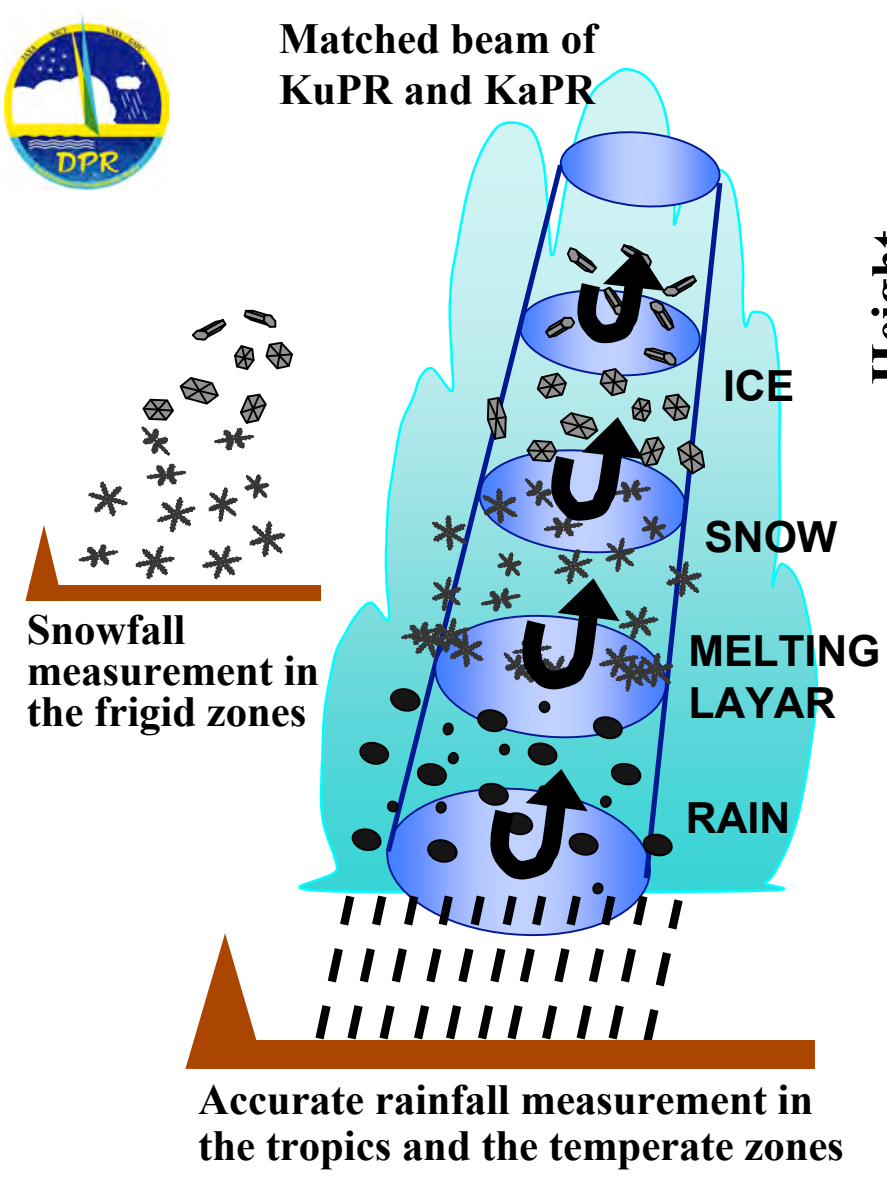
Precipitation Validation Sites

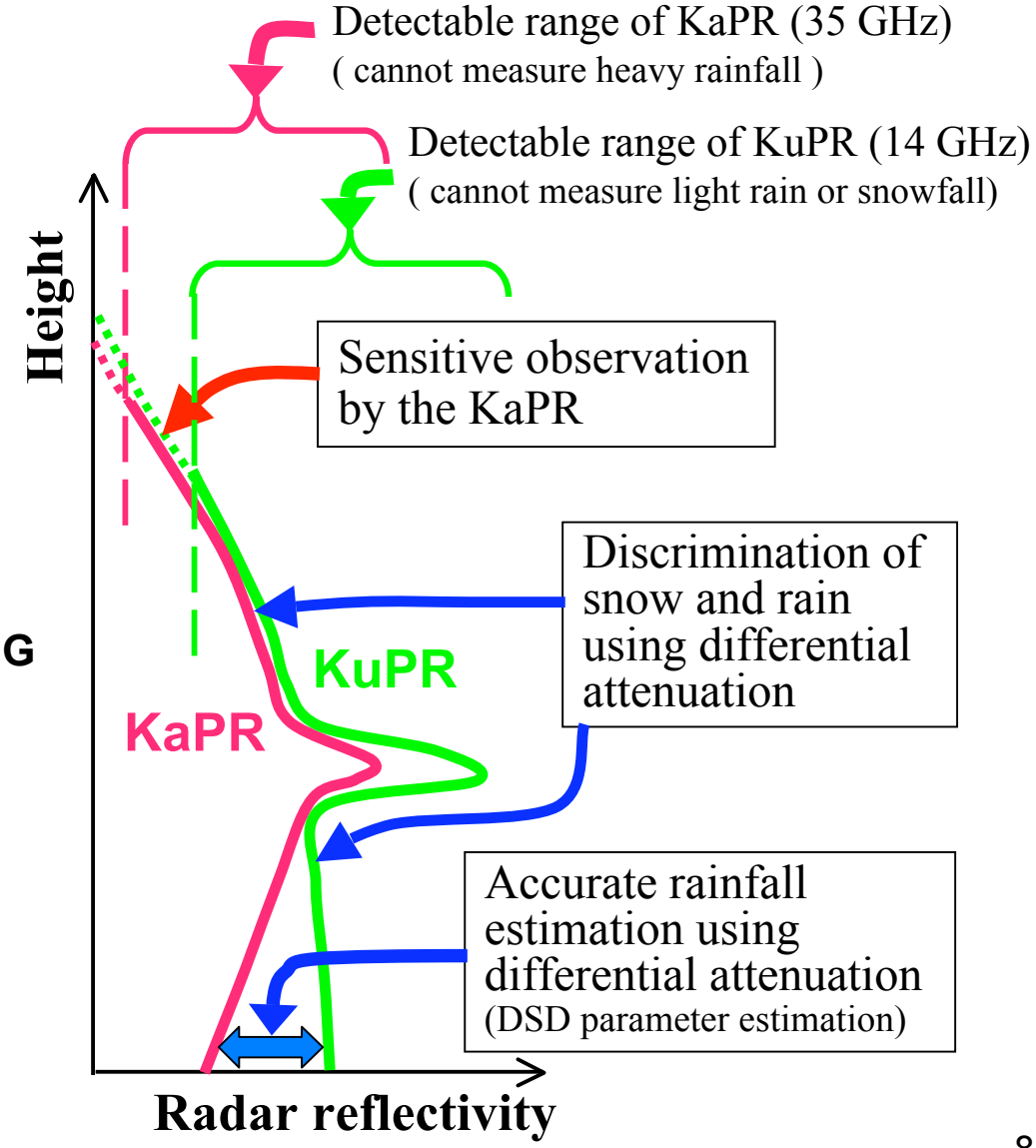
- Global Ground Based Rain Measurement

Global Precipitation Processing Centers

- Capable of Producing Global Precipitation Data Products as Defined by GPM Partners

Precipitation measurement by DPR

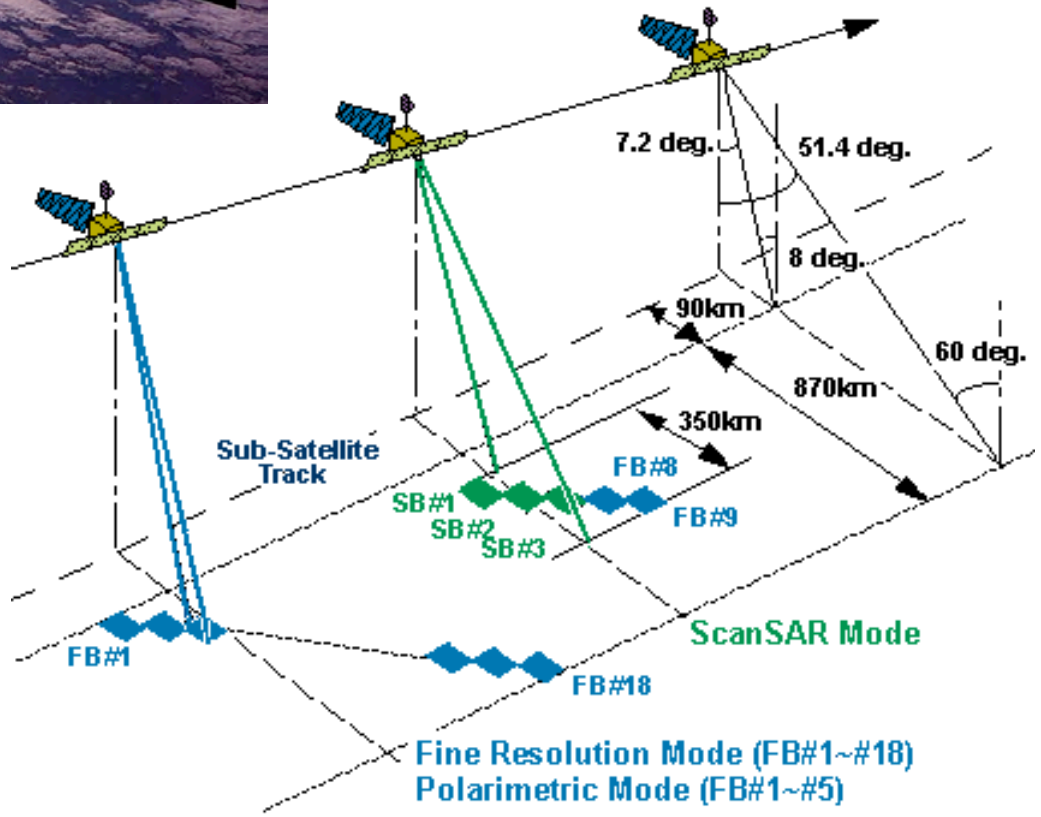




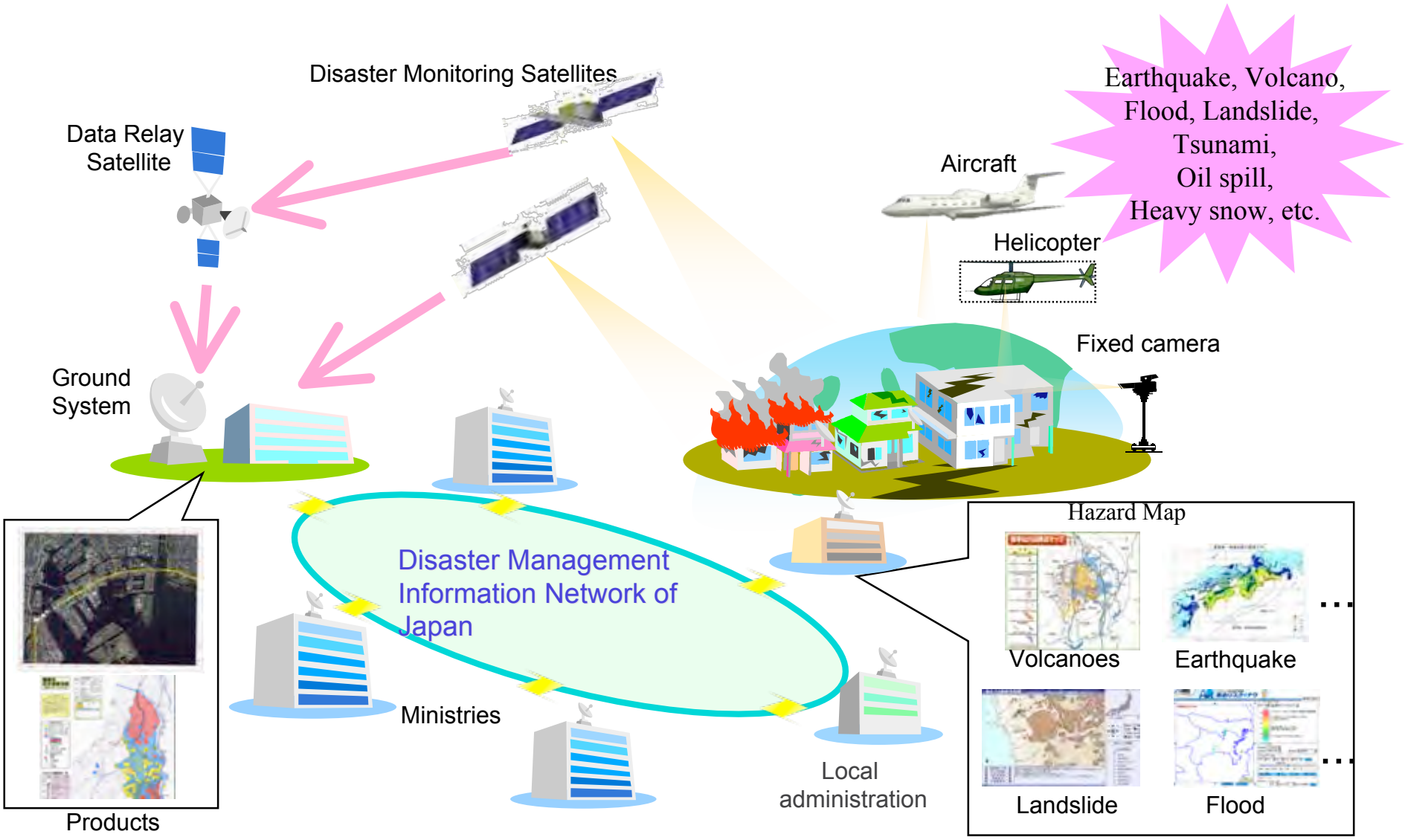
Advanced Land Observing Satellite: ALOS

PALSAR
L-band (23.6 cm)
Synthetic Aperture Radar
Polarimetry
Dual Polarization
SCANSAR

Launch:
24 Jan. 2006

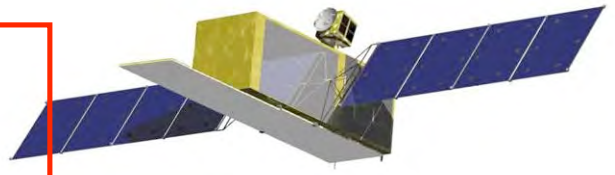


Disaster Monitoring System



DiMOS core system (2 SAR + 2 OPT)

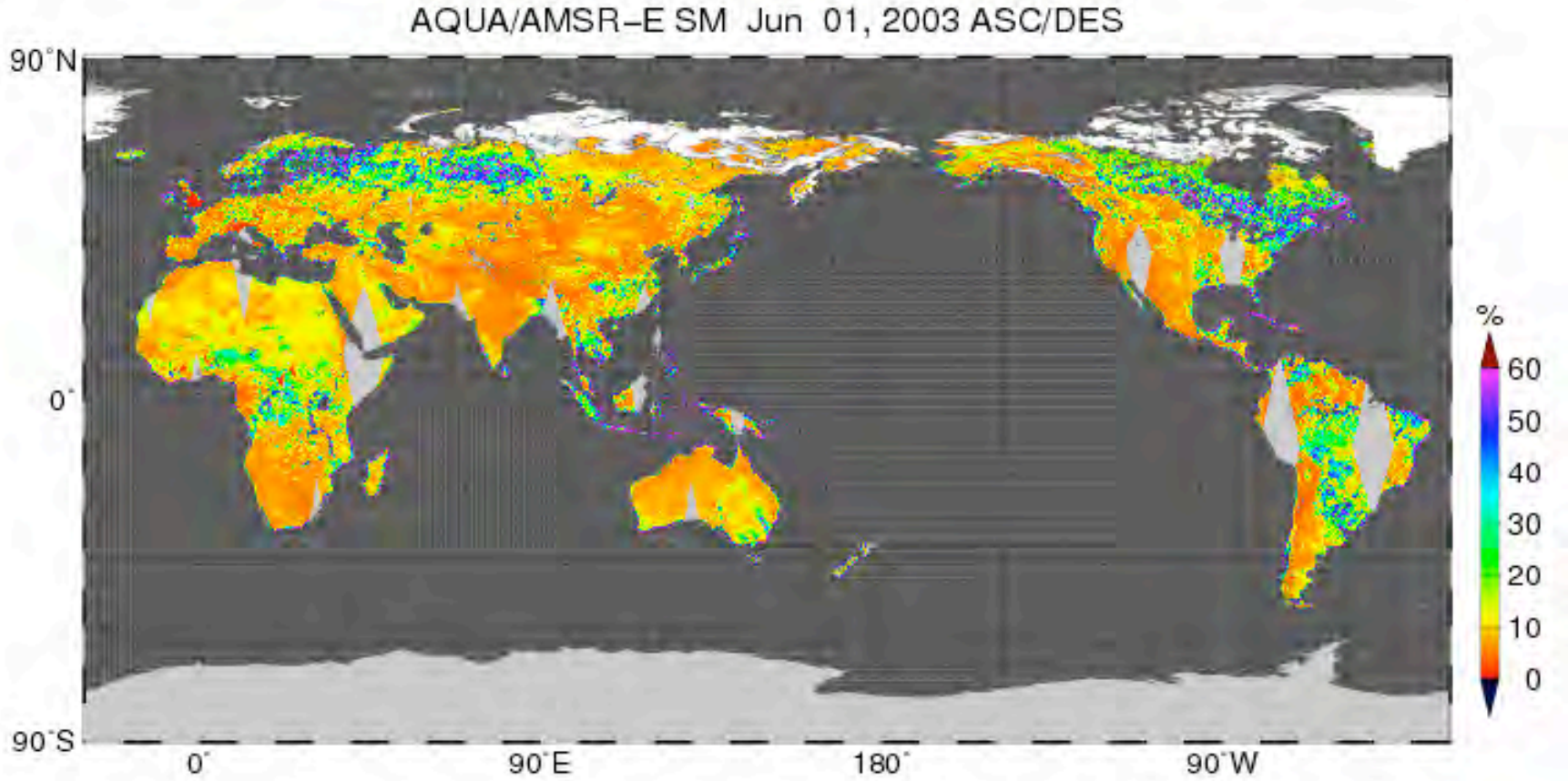
- **Satellite**
  - SAR satellite
    - GSD: 3m (strip map), 3m*1m (spotlight)
    - Swath: 50km
    - L-band
  - Optical satellite
    - GSD: 1m (Pan), 4m (Multi-spectral)
    - Swath: 50km
  - First satellite: launch target JFY2012



- **Ground System**
  - Quick response
    - Quick tasking (less than 1 hour)
    - Quick data processing and analysis (less than 1 hour for standard proc.)
  - Compatible with the existing information systems of Japanese governmental users

Soil moisture from AMSR-E observation

- C-band (7GHz) channels are currently best available frequency for retrieving global, long-term soil moisture content from satellite.
- Synergy with L-band radiometers (e.g., SMOS, SMAP) and high-resolution SAR instruments are desired.

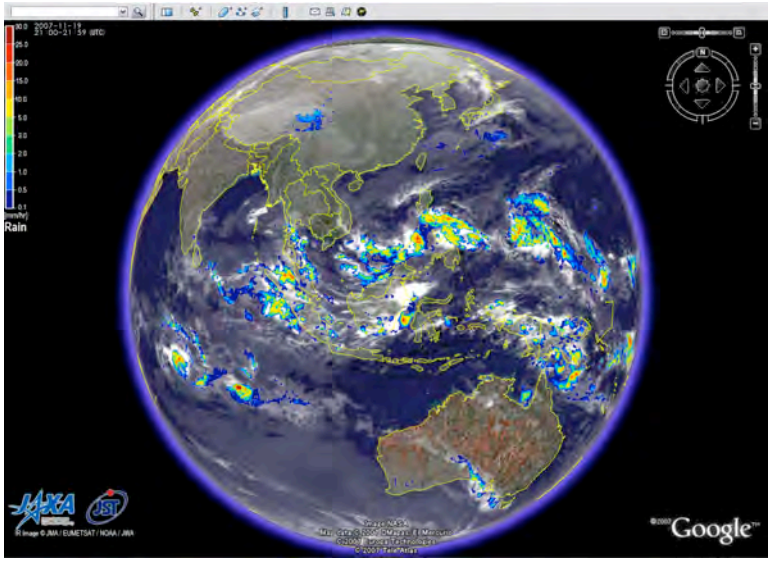


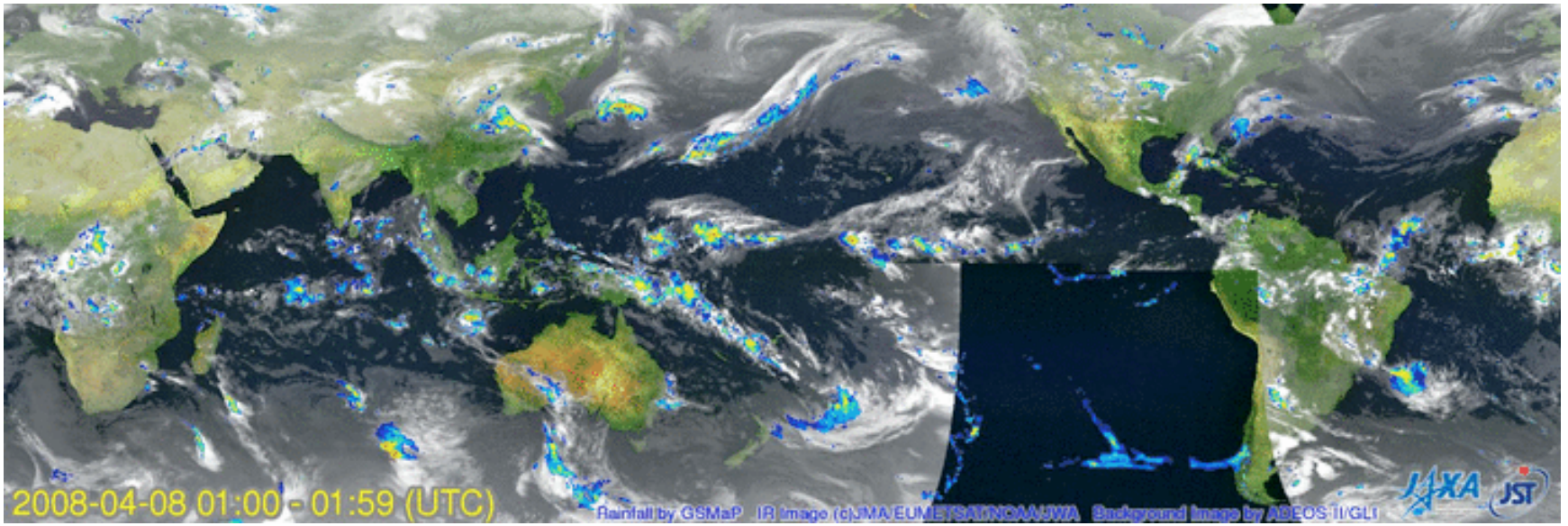
Soil moisture standard product is being generated by using 10GHz as a primary frequency due to the radio frequency interference issue in 6.9GHz band.

Poster by Dr. Hideyuki Fujii (JAXA)

Global precipitation mapping

- *GCOM-W data will be used for global precipitation mapping, particularly collaborating with the Global Precipitation Measurement (GPM) mission.*
- *As a precursor, JAXA is providing the 0.1 degree grid, hourly global precipitation map in near real-time (4 hours after observation) by using microwave radiometers, such as AMSR-E, TMI and SSM/I, and Geo-IR information.*
- *Utilizing the results of the GSMaP (Global Satellite Mapping of Precipitation) project sponsored by the Japan Science and Technology Agency.*

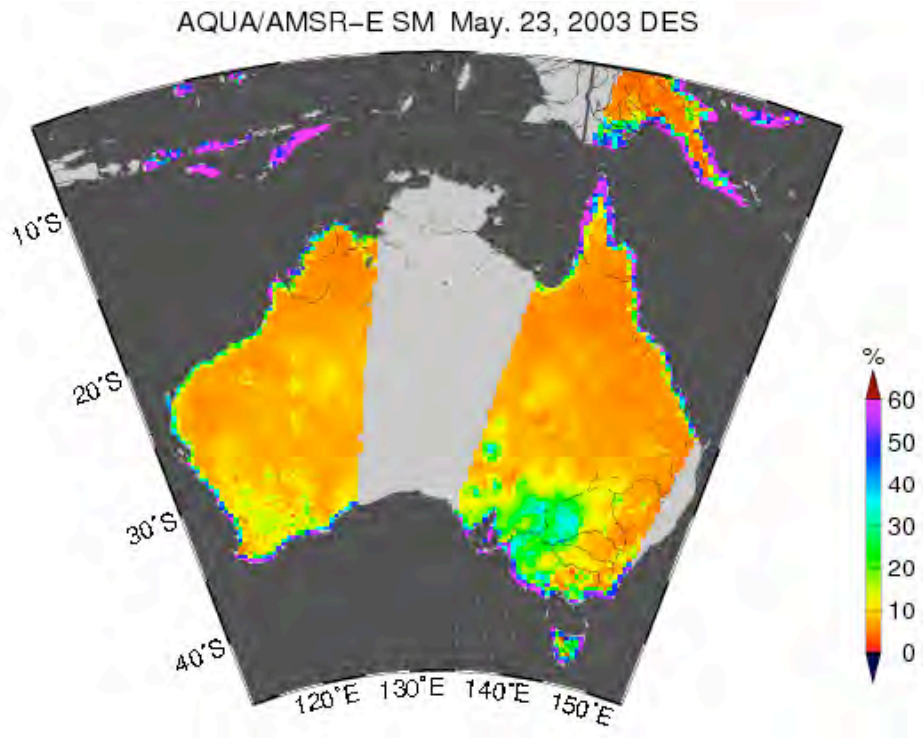


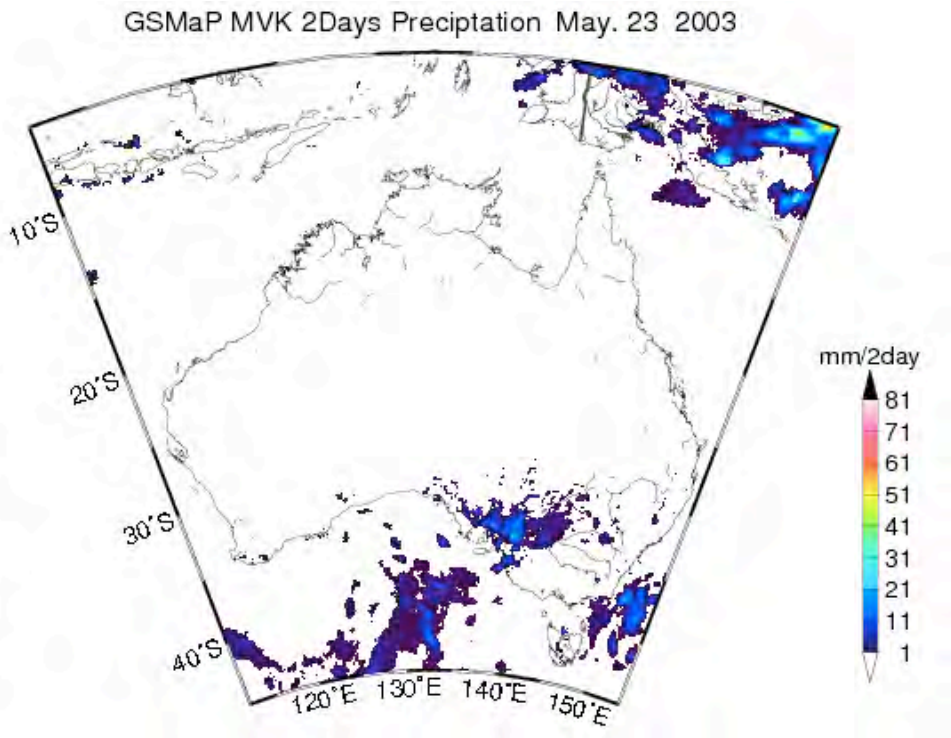


AMSR-E soil moisture and precipitation

AMSR-E Soil Moisture
- L2, Descending
- Volumetric Soil Moisture [%]

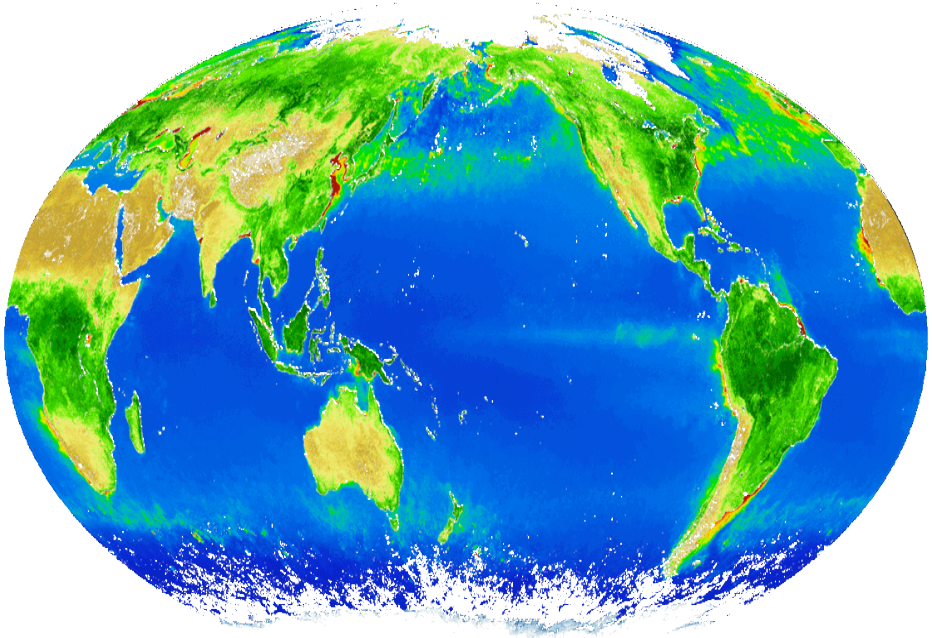
Precipitation :
- Total amount of precipitation for 48 hours before AMSR-E observation.
- Data source: GSMaP MVK hourly (JST-CREST/GSMaP)



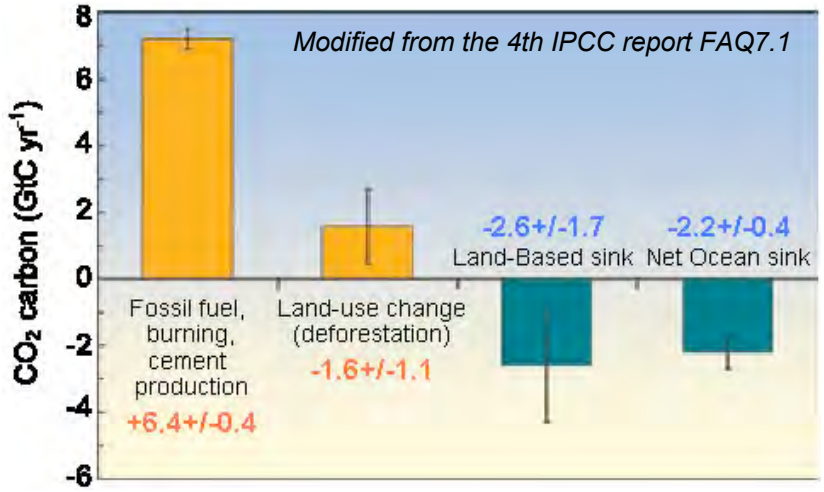


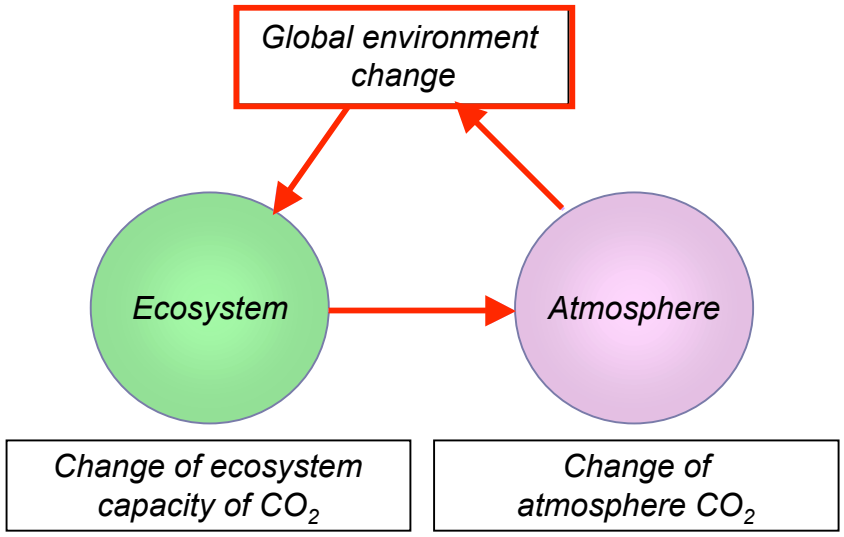
Provided by Dr. Fujii of JAXA/EORC.

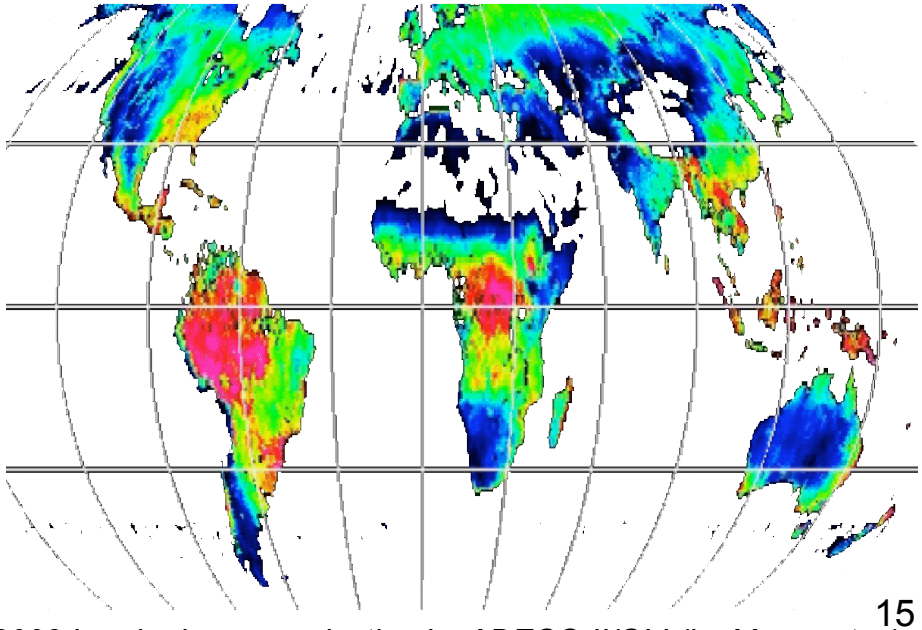
Primary Production by GLI



2003 Apr-Jun ocean primary productivity by ADEOS-II/GLI (Kameda and Ishizaka)

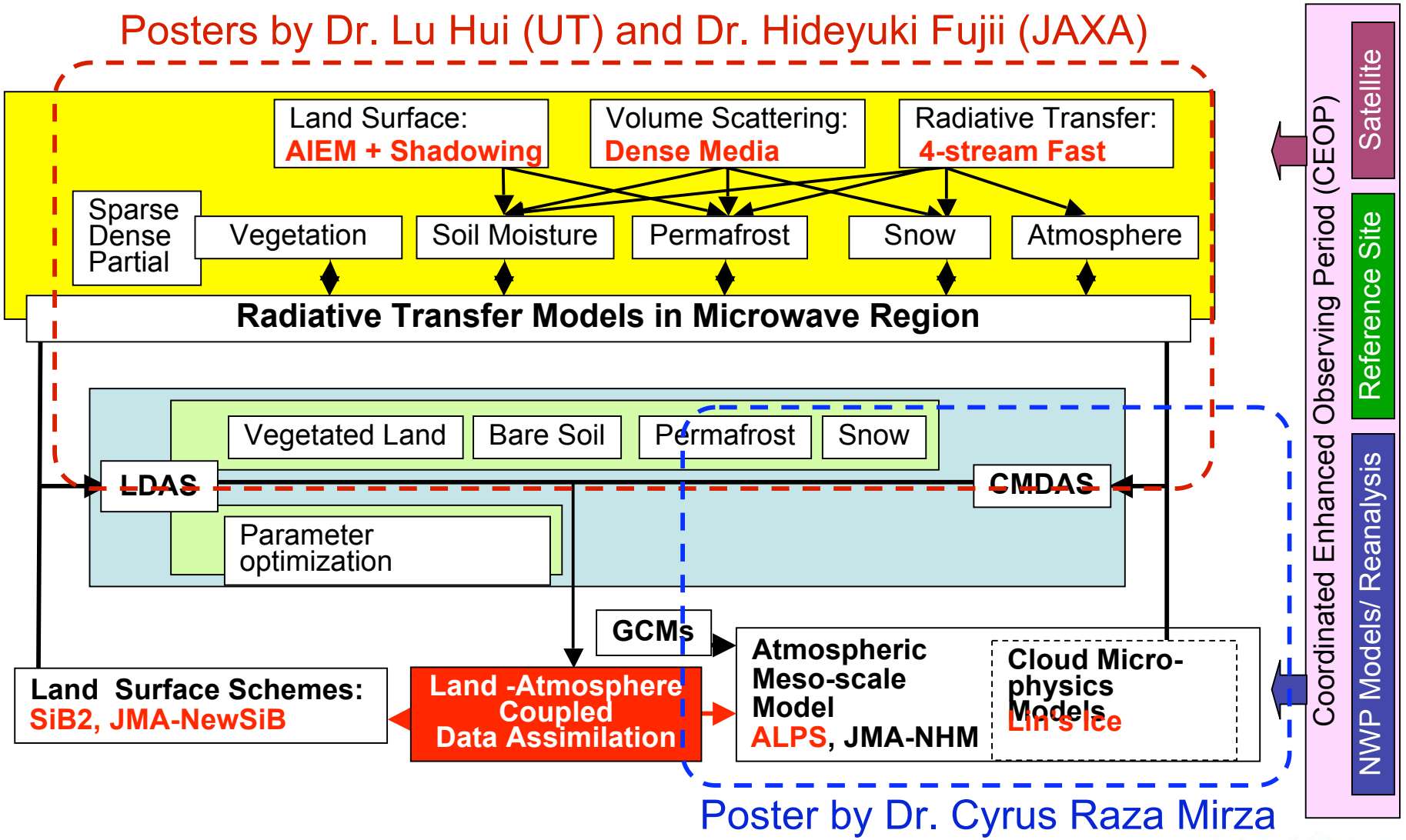




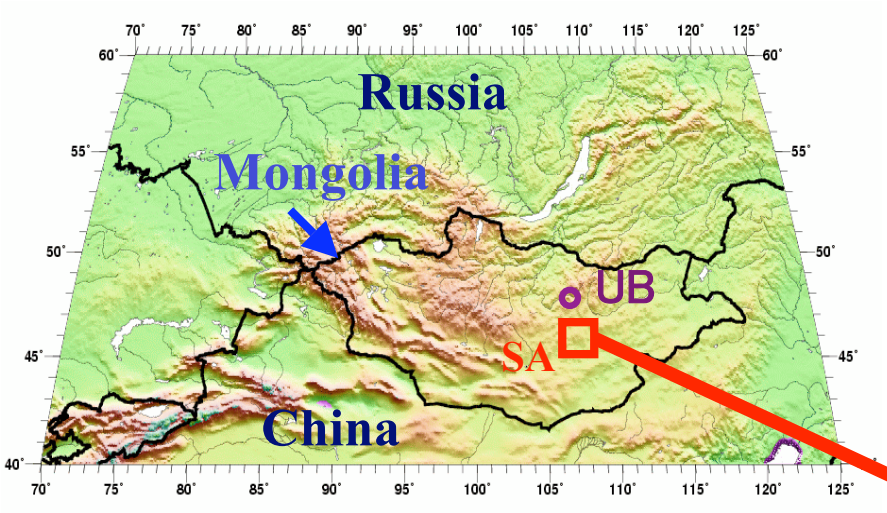


2003 Land primary production by ADEOS-II/GLI (by Muramatsu)

Hydrological Observation and Prediction System by Using Satellite Microwave Radiometers

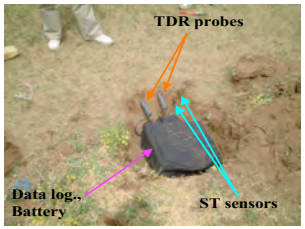


Provided by Professor Koike of the University of Tokyo.



DRS

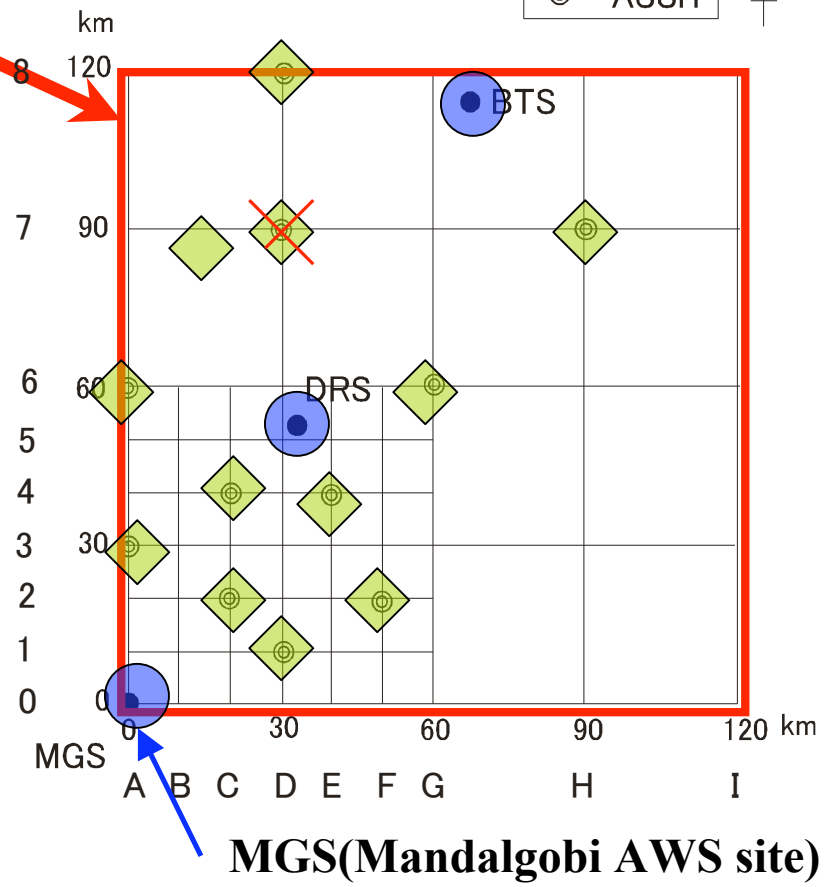
AWS in BTS



ASSH

AWS

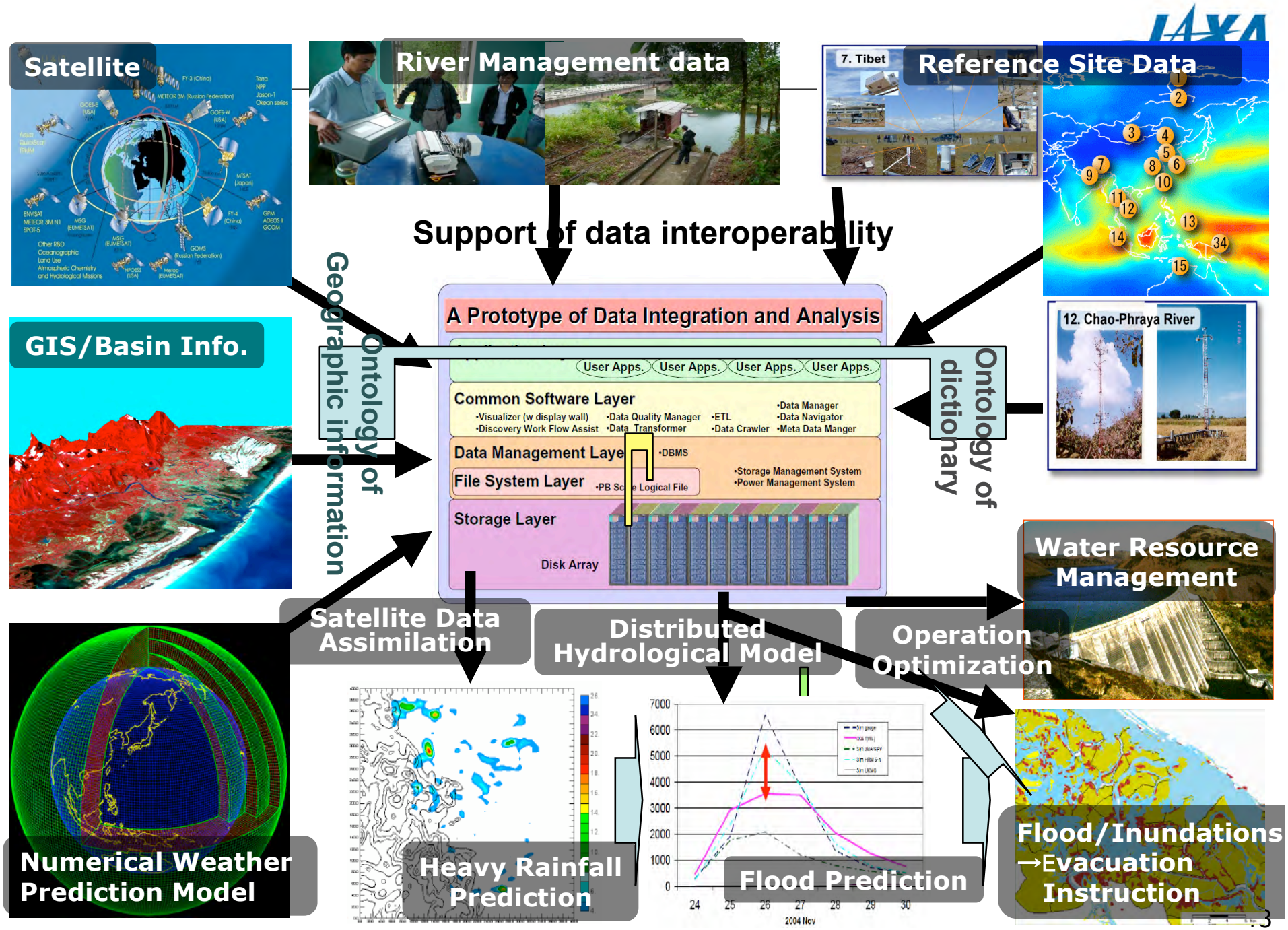
ASSH



MGS(Mandalgobi AWS site)

Working stations in the MAVEX (Mongol AMSR/AMSR-E/ALOS Validation Experiment) study area as of Dec., 2007 (:AWS (Automatic Weather Station), : ASSH (Automatic Station for Soil Hydrology) , SA : Study area of AMPEX/MAVEX, UB: Ulaanbaatar)

Provided by Professor Kaihotsu of Hiroshima University.


Satellite
River Management data
7. Tibet
Reference Site Data
Support of data interoperability
GIS/Basin Info.
Ontology of Geographic information
A Prototype of Data Integration and Analysis
User Apps.
User Apps.
User Apps.
User Apps.
Common Software Layer
•Visualizer (w display wall)
•Discovery Work Flow Assist
•Data Quality Manager
•Data Transformer
•ETL
•Data Crawler
•Data Manager
•Data Navigator
•Meta Data Manger
Data Management Laye
•DBMS
File System Layer
•PB Sc Logical File
•Storage Management System
•Power Management System
Storage Layer
Disk Array
Ontology of dictionary
12. Chao-Phraya River
Water Resource Management
Satellite Data Assimilation
Distributed Hydrological Model
Operation Optimization
Numerical Weather Prediction Model
Heavy Rainfall Prediction
Flood Prediction
Flood/Inundations →Evacuation Instruction
2004 Nov

JAXA Earth observation future missions